

1 CLAIMS

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3 1. A method comprising:

4 identifying an initial set of pitch value candidates within each frame of a
5 plurality of frames of received audio content utilizing a first pitch estimation
6 algorithm; and

7 reducing the initial set of pitch value candidates to a select set of pitch value
8 candidates based, at least in part, on pitch value re-scoring utilizing a second pitch
9 estimation algorithm, wherein the select set of pitch values are selected in
10 substantially real-time.

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12 2. The method according to claim 1, further comprising:

13 calculating a transition probability between at least one of the select pitch
14 value candidates of adjacent frames.

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16 3. The method according to claim 2, further comprising:

17 selecting a pitch value within each frame with the highest transition
18 probability between adjacent frames as the pitch value for the frame.

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20 4. The method according to claim 2, wherein the transition probability is

21 based, at least in part, on dynamic programming configured to determine a
22 significantly best path between different pitch candidates of adjacent frames.

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24 5. The method according to claim 2, further comprising:

25 smoothing a curve representing the select pitch values over a plurality of
frames based, at least in part, on other information.

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2 6. The method according to claim 5, wherein other information includes
3 one or more of an energy value for each frame, a zero crossing rate of the audio
4 content, and/or a vocal tract spectrum of the audio content.
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6 7. The method according to claim 1, wherein identifying the initial set of
7 pitch value candidates within each frame comprises:

8 passing each frame of audio content through an average magnitude
9 difference function (AMDF); and

10 selecting N near-zero minima pitch values in the audio content as the initial
11 set of pitch value candidates.
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13 8. The method according to claim 7, wherein N is set to 288 pitch value
14 candidates, selected as the initial set of pitch value candidates based, at least in
15 part, on the AMDF.
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17 9. The method according to claim 1, wherein identifying a select set of
18 pitch values comprises:

19 generating a local score for each of the initial set of pitch value candidates
20 utilizing a normalized cross-correlation function (NCCF); and

21 selecting M pitch value candidates with the highest local score.
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1 **10.** The computer readable media having computer instructions for
2 performing acts comprising:

3 identifying an initial set of pitch value candidates within each frame of a
4 plurality of frames of received audio content utilizing a first pitch estimation
5 algorithm; and

6 reducing the initial set of pitch value candidates to a select set of pitch value
7 candidates based, at least in part, on pitch value re-scoring utilizing a second pitch
8 estimation algorithm, wherein the select set of pitch values are selected in
9 substantially real-time.

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11 **11.** The computer readable media according to claim 10, having further
12 computer instructions for performing acts comprising:

13 calculating a transition probability between at least one of the select pitch
14 value candidates of adjacent frames.

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16 **12.** The computer readable media according to claim 11, having further
17 computer instructions for performing acts comprising:

18 selecting a pitch value within each frame with the highest transition
19 probability between adjacent frames as the pitch value for the frame.

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21 **13.** The computer readable media according to claim 11, wherein the
22 transition probability is based, at least in part, on dynamic programming
23 configured to determine a significantly best path between different pitch
24 candidates of adjacent frames.

1 **14.** The computer readable media according to claim 11, having further
2 computer instructions for performing acts comprising:

3 smoothing a curve representing the select pitch values over a plurality of
4 frames based, at least in part, on other information.

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6 **15.** The computer readable media according to claim 14, wherein other
7 information includes one or more of an energy value for each frame, a zero
8 crossing rate of the audio content, and/or a vocal tract spectrum of the audio
9 content.

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11 **16.** The computer readable media according to claim 10, wherein
12 identifying the initial set of pitch value candidates within each frame comprises:

13 passing each frame of audio content through an average magnitude
14 difference function (AMDF); and

15 selecting N near-zero minima pitch values in the audio content as the initial
16 set of pitch value candidates.

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18 **17.** The computer readable media according to claim 16, wherein N is
19 set to 288 pitch value candidates, selected as the initial set of pitch value
20 candidates based, at least in part, on the AMDF.

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22 **18.** The computer readable media according to claim 10, wherein
23 identifying a select set of pitch values comprises:

24 generating a local score for each of the initial set of pitch value candidates
25 utilizing a normalized cross-correlation function (NCCF); and

 selecting M pitch value candidates with the highest local score.

1 **19.** An apparatus comprising logic configured to receive audio content,
2 identify an initial set of pitch value candidates within each frame of a plurality of
3 frames of the received audio content utilizing a first pitch estimation algorithm,
4 and reduce the initial set of pitch value candidates to a select set of pitch value
5 candidates based, at least in part, on pitch value re-scoring utilizing a second pitch
6 estimation algorithm, wherein the select set of pitch values are selected in
7 substantially real-time.

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9 **20.** The apparatus according to claim 19, wherein the logic is further
10 configured to calculate a transition probability between at least one of the select
11 pitch value candidates of adjacent frames-.

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13 **21.** The apparatus according to claim 20, wherein the logic is further
14 configured to select a pitch value within each frame with the highest transition
15 probability between adjacent frames as the pitch value for the frame.

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17 **22.** The apparatus according to claim 20, wherein the transition
18 probability is based, at least in part, on dynamic programming configured to
19 determine a significantly best path between different pitch candidates of adjacent
20 frames.

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22 **23.** The apparatus according to claim 20, wherein the logic is further
23 configured to smoothing a curve representing the select pitch values over a
24 plurality of frames based, at least in part, on other information.
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1 **24.** The apparatus according to claim 23, wherein the other information
2 includes one or more of an energy value for each frame, a zero crossing rate of the
3 audio content, and/or a vocal tract spectrum of the audio content.

4
5 **25.** The apparatus according to claim 19, wherein, when the logic
6 identifies the initial set of pitch value candidates within each frame, the logic is
7 further configured to pass each frame of audio content through an average
8 magnitude difference function (AMDF), and select N near-zero minima pitch
9 values in the audio content as the initial set of pitch value candidates.

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11 **26.** The apparatus according to claim 25, wherein N is set to 288 pitch
12 value candidates, selected as the initial set of pitch value candidates based, at least
13 in part, on the AMDF.

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15 **27.** The apparatus according to claim 19, wherein, when the logic
16 identifies the select set of pitch values, the logic is further configured to generate a
17 local score for each of the initial set of pitch value candidates utilizing a
18 normalized cross-correlation function (NCCF), and select M pitch value candidates
19 with the highest local score.